THE STATE AND MEDICAL RESEARCH

The Harveian oration delivered at the Royal College of Physicians of London on St. Luke's Day, 1938

BY

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An invitation to join the procession of illustrious men who have filled the position of Harveian Orator must be regarded as one of the highest honours by any man. To one who, in however humble a way, has endeavoured throughout his working life to follow in Harvey's footsteps, the invitation has a very special significance. For Harvey stands out as one of the greatest investigators, and his work—a wonderful combination of observation and experiment—is an example of the finest achievement of the human mind. The purpose of this annual festival is not only to provide opportunity for his praise. It is an occasion to renew our vows to follow his example and to forward those projects and ideals to which he dedicated his life. Harvey had many outstanding qualities, to which reference has been made by my predecessors in this office. He was, however, primarily a discoverer and his name acts as a trumpet call to everyone with the instinct to promote the science of medicine.

His election in 1630 as physician-in-ordinary to Charles I brought him into close association with the head of the State. One of the results of this association was permission to make use of deer and other animals in the royal demesnes for study, a privilege whose fruits are evident in the treatise "de Generatione." It would be idle to pretend that this royal action showed foresight or was more than a kindness bestowed on a good servant and friend. It does not compare in dramatic and scientific quality with what is probably the first recorded experiment in medical science by a king himself—Frederick the Second, Emperor of the Romans, King of Sicily and Jerusalem, known as Stupor Mundi, the Wonder of the World, A.D. 1192–1250. Of him it is recorded that he took two knights and gave them identical meals. One of these knights he then sent out hunting and the other he ordered to bed. Several hours later he killed both and examined the contents of their alimentary canals. He found that digestion had proceeded further in the stomach of the sleeping knight. All will agree that this was a good experiment, but whether it can be classed as clinical or animal experimentation remains doubtful.

The facilities and assistance provided by Charles I for Harvey, probably the first instance of State support for medical research, are being given nowadays by the State to hundreds of investigators from public funds granted by Parliament for the encouragement and promotion of medical inquiry. That the precedent established by King Charles has now developed into an important activity of the State would have rejoiced Harvey's heart. Harvey's position as a leader of medical science is so well recognised to-day that more and more men are endeavouring to follow his example and the revolutionary changes in medicine during the past 60 years only increase the appreciation of his foresight and skill. Many still living have seen this revolutionary phase in its entirety : the introduction of new methods of prevention, diagnosis, and treatment of disease; the enormous increase in hospital accommodation ; the initiation and development of clinical laboratories and radiological departments ; and the transformation and multiplication of the public health services. These developments are mainly due to the great increase of knowledge acquired from investigations made in the past 60 or 70 years. People began to realise then that health and disease are not conditions conferred upon man for humble acceptance, but that a certain method (Harvey's method) of acquiring knowledge is at hand whereby disease can be combated and death itself warded off. More men and women started investigations, knowledge accumulated, success bred success, and civilised man developed a spirit of optimism in health matters.

How recent has been the acceptance in this country of the new spirit can be seen from the late Earl Balfour's words in 1896 : " I have all my life been an ardent believer in a cause which is often laughed at—the cause of the endowment of research. In that cause I most firmly believe and I think there is no branch of knowledge in which it may find a more useful field of application than in that of advancing medical knowledge." In 1900, pointing out how disgraceful was the equipment for medical research in this country compared with Germany, France, Switzerland, and Italy, he said " let us not be backward in this great international competition which surely may be said, in some way, to balance that more costly and destructive competition in armaments and, it may be, in commerce."

In this country, and even more so in the United States of America, scientific research is not supported by the public, even the enlightened public, on intellectual grounds but because it has been found to deliver the goods often enough to deserve special encouragement. In Germany, on the other hand, it had been accepted for a hundred years or more that medicine should be taught by those who could extend or had extended the boundaries of knowledge. Though great medical discoveries were made in the past century outside Germany, the researches which led to them were made by men of genius working independently and often under uncongenial conditions. Germany alone had an academic atmosphere saturated with the research spirit.

Whatever may be the present or future state of science in Germany, we ought to remember with appreciation the enlightened attitude which flourished at a time when medical research breathed but feebly elsewhere. Nor, in these earlier times, was the outlook utilitarian. The work of Purkinje, Johannes Müller, and Virchow did not suggest the cure or elimination of disease. A time came, however, when it was apparent that medical research could and did forge weapons to fight disease. With the discovery of antiseptics, antitoxins, and Salvarsan it came to be realised that medical and other research was not just an interest of a few curious people with a special aptitude for discovering facts with but little bearing on life. Wise men, both in public life and industry, saw that scientific research was the life-blood of modern existence—a means of providing easily the needs of mankind and the knowledge necessary for healthy existence under modern conditions. As might be expected, the earlier disinterested German attitude was first affected by the practical issues, and organised research there received even a greater fillip. Industrial leaders in Germany and in the United States of America also soon grasped that in industry it was good business to throw a sprat of expenditure on research to catch a mackerel of large profit.

It has been sometimes said that it took the great war to make this country realise the importance of scientific research, and it is true that the Department of Scientific and Industrial Research was only set up in 1915, largely as the result of the urgent demands of war. The Medical Research Committee, however, was initiated in 1913. Practically all its activities until 1919 were directed to the solution of medical problems related to war, and right well did it justify itself.

The Source of Funds

Private endowment of research, medical or industrial, has no proud history in this country, although there are a few fine exceptions in medicine, and the large private endowments of medical research in America make our own public resources look meagre. Some of these endowments are expended internationally, a wise policy because all mankind can share immediately in the benefits of new medical discoveries wherever they are made. If the extensive support given to British medical research by the Rockefeller Foundation pricks the conscience of many Englishmen, the stimulus is not often big enough to produce a satisfactory response. During the present century rapid increases in medical research activity have taken place in this country and in the U.S.A. ; ours has been organised and largely financed by the State, while theirs has been richly endowed and controlled by private interests. Both movements are of the greatest scientific and social significance, and each has already produced a good harvest, but the crops differ in many respects. The American record during the past 20 years has been a very fine one. There is good reason to believe that in America the State intends to supplement private endowment for medical research, and the Nuffield scheme at Oxford is possibly an indication that private persons here will, in future, be more likely to regard such research as worthy of support.

Financial aid from one or other source is essential. Money cannot, of course, buy discoveries, certainly not great discoveries, as it can buy manual labour, but it can release those with the necessary ability from the need of earning a living by ordinary work and enable them to devote their lives to research. Until recently scientific discovery in this country has depended only too often on the haphazard distribution of wealth. Sometimes, as with Darwin, private means have allowed leisure for experiment and contemplation. Sometimes a society, such as the Royal Institution, has subsidised men like Humphry Davy and Faraday in the same way as Trinity College, Cambridge, subsidised Newton. If these men had depended for their living on ordinary labour the discoveries associated with their names could hardly have been made by them. On the other hand, some of the best work has been done by men labouring under conditions of extreme simplicity. Would, for instance, the work of Claude Bernard and Pasteur have been better had they received abundant financial support early in their lives ? It was when their work was more or less finished that they were given adequate laboratory facilities, not while they were making their great discoveries. The Harveys, the Claude Bernards, and the Pasteurs of this world will make discoveries with meagre apparatus and accommodation ; more money or improved facilities will not swell their output and may indeed detract from its quality.

The historical instances of men given slight but real opportunity who have made discoveries of the first order have imbued us all with the determination that genius shall not in future be lost to the world by lack of money to provide such opportunity. The mental outlook and ability to discover is present throughout all grades of society, though it may not be equally distributed. The real discoverer is rare in all classes and it must be the object of civilised communities to find him and foster his activities. Those who choose research for their life's work are mostly content with a lower standard of living than that which they could often obtain in other walks of life. Though generally the more able the investigator the less his demands on life's amenities, the scientific genius when found must not be expected to use all his time and energy fending for a living. The larger number of men who work out the rich veins discovered by their leaders must also be looked after and given facilities for their work.

All will agree that this was the justification in this country for State support for research, failing adequate private endowment. State support, however, must be associated with State control which may be repressive and bureaucratic. The words control and bureaucracy have a disagreeable sound particularly in the ears of those searching after truth by experiment, when success depends upon freedom to work quietly. One of the main objects of this discourse is to show how State control of medical research can be compatible with freedom to the investigator; another is to explain the way in which State funds are used for the purpose of promoting discovery in medicine. A year ago Mr. Fosdick, the eminent president of the Rockefeller Foundation of New York, challenged me to define the general policy of the Medical Research Council in financing research workers. My inadequate answer was that their policy was to have no policy but to find the right men and back them in every way possible. Though this answer has an element of truth, and I propose to expand it here, I soon realised how misleading it might be.

History has demonstrated clearly that State endowment is compatible with the best type of medical research. Sir William Osler wrote in 1914 :—

> "Is freedom of research necessarily shackled in Government harness? Certainly not in autocratic Germany, where the Reichgesundheitsamt was the centre of the free and brilliant researches of Koch and his colleagues, not only missionary researches in many parts of the world, but practical health campaigns, such as that against typhoid fever which could never have been undertaken without strong financial backing. Certainly not in democratic America, in whose Government bureaus Theobald Smith initiated those epoch-making studies

on protozoal diseases, in which Walter Reed and his colleagues solved the problem of yellow fever and from which Stiles started on a world-wide campaign against ankylostomiasis—all memorable and life-saving investigations."

There was no reason why first-class medical research should not be done under State control in this country too. It is now 25 years since the Government decided to set up the Medical Research Committee under the National Health Insurance Joint Commission to administer funds provided by the National Health Insurance Act of 1911. This arrangement was terminated in 1919, and in 1920 the Medical Research Council received their present title and constitution. Funds for their work were provided directly from the Treasury in the form of a Parliamentary grant-in-aid and the Council became subject to the general direction of the new Committee of the Privy Council for Medical Research with the Lord President of the council as chairman.

Certain Dangers of State Control

POLITICAL INFLUENCE

Some will wonder whether a system of State support does not lend itself to political influences of a kind which may interfere with the character of work done and even bias results or their interpretation. This danger is implicit in any State activity, and safeguards against it can easily be devised. In this case, while Parliament has ultimate control the Council have been given great latitude in their policy and finance, and the disposal of the funds supplied is at their complete discretion.

Of the present 11 members of the Council, 8 are men chosen for their scientific and medical qualifications, each name being approved not only by the Lord President of the Privy Council but also by the president of the Royal Society. Only two members are politicians in the sense that one must represent the House of Lords and the other the House of Commons. At present the remaining member, the treasurer, is a distinguished banker. Direct political influence is not likely to affect the decisions of a body of this nature. Lest it should be exerted through the permanent officials, the Secretary of the Council is elected by the Council itself—i.e., by the scientific majority of the members. As the Secretary acts also for the Committee of the Privy Council of Medical Research, there are no administrative officials or machinery standing between the Medical Research Council and the Lord President of the Privy Council. Thus the Council consist mainly of a group of experts in medical research with full authority to use and control the public money placed at their disposal, independently of all other bodies.

In my experience not only has political influence been absent but even political interest has been uncommon. Now that the number of requests from other Government departments for help is growing rapidly, questions and discussions arise in Parliament which are often not conducive to the quiet unbiased investigation of difficult medical problems. Needless to say every precaution must be and is taken to protect scientific workers engaged in these investigations. It is clearly necessary to be constantly alert to prevent the possibility of results and deductions from being influenced by political interest, for if once bias due to this or other cause entered into any inquiry, the Council's reputation would be tarnished. All concerned may rest assured that political influence has not had and probably will never have any detrimental effect on medical research controlled by the Council as at present constituted.

DICTATORSHIP

Another doubt sometimes expressed is whether any group of men, however able, should be in a position to act almost as dictators in a whole branch of scientific study, lest they should act as a body of official interpreters, and if they are wrong, misdirect the lines of investigation and even distort the interpretation of results. A sure safeguard against the continuation of any biased attitude on the part of the Council is the constant change of personnel, whose individual term of office is four years. But this question has a bearing on the Council's refusal to accede to the appeals occasionally made for moral backing of particular views and for a pontifical declaration in favour of special solutions of problems of health and disease.

For the most part financial support is given to good work, though occasionally work of a more doubtful quality is assisted until its true value is seen ; but in any case the results obtained and the views expressed are those of the individual investigators and not of the Council. The danger of being charged with shouldering the responsibility for particular views of medical problems often prevents the Council from referring to discoveries which they have helped, or from giving the great praise sometimes due to specific research. Some may deplore a limitation which may and indeed does result both in delay in the appreciation of good and in the denunciation of bad work. But an official body must not assume too much authority as to what is acceptable or unacceptable, and fortunately, in these days when many indefatigable workers out for the truth are prepared to praise and unafraid to condemn, the establishment of true values is rarely delayed.

APPRAISAL

Mistakes in appraisal are inevitable; relatively poor workers may stand, especially in the eyes of their near colleagues, on a pedestal of distinction and, much more serious, the first-class discoverer and his work may go unrecognised. It is not so long ago since Lister passed through 10 years of obloquy before the value of antisepsis was accepted. The Medical Research Council can do something to prevent such incidents by arranging for the repetition of the criticised investigations, but that is not enough to prevent the harm that may ensue from irresponsible criticisms. In all applied science there are a few men who have contributed nothing to knowledge but have sought recognition as authorities by criticising the work of others. The man of criticism is in a safe position because, if he is wrong, people forget about it; if he is right, he is regarded as an oracle. If the discoverer is wrong, either in fact or in interpretation, he stands the chance of having his future work disregarded or his spirit so broken that he foresakes the field. Long experience has taught me that it is seldom in the facts of a discovery, but rather in their interpretation, especially the first interpretation, that mistakes are made.

The appraisal of a new discovery, especially when repetition of the work needs much time and care, is clearly difficult. Nor, so far as the individual worker is concerned does the matter end always with its acceptance. The following letter, written by Lord Conway to his daughter-in-law, Anne Conway, in 1640,† shows that even Harvey's reputation as a clinician was anything but raised by his discovery of the circulation of the blood. Anne Conway suffered severely from recurrent headaches and Harvey at one time was her doctor. Subsequently many other physicians endeavoured to free her from this disability.

> Daughter,—I am very glad of your health. . . . I hear that you have a great good opinion of Dr. Harvey. I think you do well to love and respect a person of his merite for I think he hath deserved extreamely well of all learned men, for what he hath found out, or offered to the world to enquire farther into; he is a most excellent anatomist, and I conceive that to be his Masterpeece,

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† Conway Letters. By M. H. Nicolson. London. 1930.

which knowledge is many times of very great use in consultations, but in the practicke parte of Physicke I conceive him to be to mutch, many times, governed by his Phantasy, the excellency and strength whereof did produce his two workes to the world.‡ . . . If I had not a great desire to keepe you I would not write anything against Doctor Harvey whitche might in any kinde seeme to preiudice him, for I do greatly esteeme and value him, but I think this is trueth as it is that I beleave that my sonne would not know where to find such a wife nor I sutch a daughter, therefore I pray preserve yourselfe for your owne sake, and then if there be any place left for

Your most affectionat father

Conway and Kilulta.

Paris, Aug. 9th, 1640.

This letter has a familiar ring, but we may hope that it will not prevent the many young medical men undertaking clinical research from entertaining and establishing by experiment "phantasies" as important as that of the circulation of the blood. Wrong personal judgments and false values are always liable to occur and this is one of the strains which individual workers must expect to suffer. But none can doubt that the estimation of the relative value of discoverers and their discoveries is of great moment to the Medical Research Council, all of whose actions in promoting research are a reflection of their judgment of men and their investigations. In my experience of the Council's work more mistakes of judgment are due to benevolence than to harshness.

In these times especially, when discoveries in medical science are coming so fast that it is difficult for those "in the practicke parte of Physicke" to take full advantage of them, it is important that the attitude of the Royal College of Physicians, which has the right and duty to pronounce on such discoveries as are of practical import, should be enlightened, balanced, and just.

Work of the Medical Research Council

A brief description of the mechanism and some of the general principles guiding the actions of the Medical Research Council is set out below because (1) many medical men interested in research are not familiar with them, and (2) a number of countries have recently embarked on similar projects, some of them with a type of organisation less likely, according to our experience, to give the best results.

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‡ Cf. John Aubrey, "Lives," London, 1813, p. 300. "I have heard him say, that after his booke of the Circulation of the Blood came out, that he fell mightily in his practise, and that t'was beleeved by the vulgar that he was crack-brained: and all the physitians were against his opinion and envyed him."

ADVISORY COMMITTEES

For general guidance of detailed work, the Council rely on the advice of special committees. Here again the question of personnel is crucial; every member should be chosen primarily because of his capacity to aid investigation. Representation either of territory or of learned societies must be absolutely subsidiary to the main purpose of research itself, and on committees detailed technical knowledge and sound judgment alone are essential. Representation on committees must be that of research in different parts of the special field of investigation and it is wise to have a number of active workers in any body whose duty it is to plan, initiate, and guide investigation into unknown territory.

The Medical Research Council have 27 such committees, which include those for clinical science, therapeutic trials of new remedies, anæsthetics, human nutrition, vitamins, dental disease, mental disorders, tuberculosis, radiology, radium beam therapy, vision, hearing, hormones, bacteriology, bed-bug infestation, chemotherapy, statistics, school epidemics, human genetics, tropical medical research, industrial pulmonary disease, toxicity of industrial solvents, physical exercise, industrial psychology and heating and ventilation. The Industrial Health Research Board, an important subsidiary of the Medical Research Council, also receives advice and guidance from those committees whose work is primarily associated with problems of industry. Some of them are appointed conjointly with other bodies, for instance, with the Royal Society of Medicine (anæsthetics), the Lister Institute (vitamins), the British Empire Cancer Campaign (radiology), the Department of Scientific and Industrial Research (heating and ventilation), and the Agricultural Research Council (tuberculosis).

The services of all the members of these committees are given voluntarily and I should like to take this opportunity to refer to their magnificent work in giving advice and help which is essential for the work of the Medical Research Council. It is particularly pleasing to record that nearly 60 of the members of various committees are fellows or members of this College and 15 are fellows of the Royal College of Surgeons. The Council owes a great debt of gratitude to the willing coöperation they have always received from the two Royal Colleges ; any State institution which can call upon such ready and voluntary help must consider itself blessed.

FINANCE

The annual grant from the State to the Medical Research Council is now £195,000, nearly four times as much as the Medical Research Committee received at its inception 25 years ago. The block grant is considered every five years, a method which gives the Council the advantage of being able to plan ahead with some feeling of security, and the disadvantage of having to provide suddenly for expensive research, often at the request of other Government departments, out of a fixed income, thus having to curtail the natural programme. It tends to lead to periods of expansion followed by periods of penury. The present time is one of penury. One year of penury in five is probably good, as it gives an opportunity for reviewing research programmes more closely and cutting out any dead wood. With increased experience, however, dead wood becomes more and more rare, and it is nowadays very difficult to save in this way during times of financial stress.

In addition to its public funds, the Council are in a position to help directly or indirectly by advice in the disposal of private endowments for medical research. Private funds held by the Council for disposal as interest or capital amounts to over £100,000 and, in addition, they receive sums—amounting to £12,000 per annum—for special purposes from the Rockefeller Foundation, the Dental Board, the Leverhulme Trustees, the British Empire Cancer Campaign, and the Halley-Stewart Trustees. Altogether the sum at the disposal of the Council amounts to about £220,000 per annum.

The meagre financial support provided by the State for medical research has recently been criticised, both in the press and in Parliament. It has been asked why, since it is mainly by research that the Government can hope to reduce sickness and the expenditure it involves, only £195,000 per annum is provided by the Government for research on disease which costs the country from £200,000,000 to £300,000,000 annually. This public expression of concern is satisfactory as a sign of confidence that the annual grant has been justified ; and there is no reasonable doubt that in course of time more money, which is certainly required, will be forthcoming. The Treasury naturally demand that every request for an increase in research expenditure shall be justified. The Medical Research Council's finance has been slowly and steadily built up and on the whole it has provided the means for progressive development. The main limiting factor in all research activity is personnel, and the number of people who are trained for and capable of doing medical research is not large. By various means the Council are endeavouring to increase this number and more money will be required when more trained investigators are available. Some system must also be sought for financing sudden important calls for organised research made by other Government departments, which at present interfere with the normal programme of development.

There are three main directions in which the Council dispose of the money: (1) the establishment and maintenance of the National Institute for Medical Research at Hampstead and Mill Hill; (2) the maintenance of a number, rapidly growing, of research units, both clinical and laboratory, and of whole-time workers at various centres; and (3) the provision of grants to individual workers for specific pieces of research at many of the universities and hospitals throughout the country.

NATIONAL INSTITUTE FOR MEDICAL RESEARCH

This organisation was set up with the idea of doing large-scale and long-distance work requiring investigation by teams, and of a nature not suitable for university or hospital laboratories.

Here, under the direction of Sir Henry Dale, F.R.S., the work is done in two main divisions: physiology, pharmacology, and biochemistry on the one hand, and experimental pathology and bacteriology on the other hand. An active subdivision of the former is endocrinology, while subdivisions of the latter include protistology and microscopic and physical methods. In addition there is a department of biological standards whose personnel is small, since every member of the staff of the National Institute is expected to contribute his special knowledge of a particular problem to this important part of the work.

The work of the National Institute has always reached the highest standard. To recall the many triumphs would be a pleasant task, but I must here dwell on one aspect only of its work, of particular interest to the practising doctor.

Standardisation of biological substances.—In this work the National Institute has led the world and has rendered a great practical service to mankind. Here have been devised, are held and distributed, standards required by the British Government for the purpose of the Therapeutic Substances Act, others for the Health Organisation of the League of Nations, and some made necessary by the inclusion in the British Pharmacopœia of biological assays for certain remedies. The following standards are held at the National Institute.

Antitoxins and antisera.—Tetanus antitoxin; diphtheria antitoxin; gas gangrene: antitoxin (*a*) perfrigens, (*b*) vibrion septique, (*c*) œdematiens; staphylococcus antitoxin; antidysentery serum (Shiga); antipneumococcus serum, types 1 and 2.

Drugs.—Digitalis, ouabain, strophanthin, arsphenamine, neoarsphenamine, sulph-arsphenamine.

Vitamins A, B, C, and D.

Hormones.—Insulin; pituitary (post. lobe); œstrus-producing hormones: (*a*) hydroxyketonic form (œstrone), (*b*) benzoate form (œstradiol monobenzoate); male sex hormone (androsterone), corpus luteum hormone (progesterone).

Recently additional standards have been adopted by the Health Organisation of the League of Nations for 4 of the active principles of the anterior pituitary gland and these will be prepared and stored at the National Institute.

The fact that a doctor prescribing these drugs knows their exact strength in terms of units of activity is due largely to the endeavours of the workers at the National Institute for Medical Research. In the establishment of standards adopted internationally workers of many other countries have also played an important part. Needless to say it is not only practising doctors who profit by the standardisation of drugs. Discovery itself goes forward much more rapidly when investigators know the exact strength of the biologically active compounds with which they are working.

In addition to this service, the Medical Research Council maintain at the Lister Institute a *National Collection of Type Cultures of Micro-organisms*, so that any doctor in the world can obtain for a nominal sum a specimen culture of almost any type of micro-organism. No less than 5000 such applications were made last year. Similarly standard bacterial suspensions and sera for the diagnosis of enteric, dysenteric, brucella, and meningococcal infections can be obtained from the *Standards Department* maintained at the pathological laboratory of Oxford University by the Council. This work necessitates continuous research both in the maintenance of standards, in the search for new ones, and in helping towards a solution the innumerable problems which arise during their use.

RESEARCH UNITS AND EXTERNAL STAFF WORKERS

The second line of policy adopted by the Council for promoting medical research—the placing of units of research in different institutions—has shown great developments in recent years and its progress is limited only by finance and personnel. The Council make themselves responsible for the payment of salaries and the actual cost of the research at such units, but the university or hospital is expected to provide accommodation, ordinary services and, where appropriate, beds and nursing facilities. The success of each unit depends largely on the choice of a suitable director, who joins the Council's whole-time staff; the unit forms an integral part of the institution to which it is attached and comes to be regarded with pride by its hosts. The following units have been established by the Council :—

(1) The department of clinical research at University College Hospital; (2) the neurological research unit at the National Hospital for Diseases of the Nervous System; (3) the department of research in puerperal infections at Queen Charlotte's Hospital (with the aid of (*a*) the Rockefeller Foundation, and (*b*) the Pilgrim Trust); (4) the department of bacterial chemistry at the Bland Sutton institute of pathology and Courtauld institute of biochemistry of the Middlesex Hospital, with the help of the Leverhulme and Halley-Stewart Trustees; (5) nutritional units (*a*) at the Lister Institute, and (*b*) at the Dunn nutritional laboratories, Cambridge; (6) a unit of clinical research at Guy's Hospital; (7) a unit of research on mental defect at the Royal Eastern Counties Institution, Colchester; (8) a unit of research in experimental and clinical surgery at Edinburgh University and the Royal Infirmary, Edinburgh; (9) a department of statistics at the London School of Hygiene and Tropical Medicine; (10) a unit of industrial psychology at Cambridge University.

Other members of the staff of the Medical Research Council are seeded in other universities and hospitals, each an expert in his own line and acting as a central stimulus to those around. Some of the subjects and presented by these workers include :—

(1) Experimental pathology; (2) diseases of children; (3) inheritance and disease; (4) physiology and pathology of vision; (5) biological effects of radiation; (6) pathology of the nervous system; (7) growth and development; (8) bacteriology of tuberculosis; (9) enzyme chemistry; (10) chronic pulmonary disease of mine workers.

The influence of this policy on medical research in individual universities, hospitals, and medical schools is undoubtedly great. Some of the appointments are too recent to have developed their maximum effect, but the work done in some of the older established units has achieved international repute. There are still many important gaps and the expansion of the policy will undoubtedly continue.

RESEARCH GRANTS: PERSONAL AND EXPENSES

The third part of the Council's policy is the allocation of personal and expenses grants to individuals. The personal grants are usually limited to three years. This rule is not so rigidly enforced as to cut short promising and successful research, but its adoption was forced on the Council, after many years of experience, by the number of grantees who became "dug in," with the result that much of the Council's money was apt to be frozen in relatively unproductive research. The essence of this part of the expenditure is to be fluid, so that new problems can be attacked and new personnel given a chance to try their hand at research.

The initiative for these grants nearly always rests with the head of a laboratory or hospital in favour of some individual worker, or with the worker himself. The success of the application depends upon the individual and his choice of subject, and the kind of help given varies from personal grants for whole- or part-time work to provision of research expenses or, to established workers, of means for technical assistance. It is in this part of the Council's activities that the various committees are most helpful.

It is difficult to appraise the real value of this policy. It is the side of the work of the Council of which most is heard. A survey of acknowledgments in scientific and clinical journals reveals the number and nature of these grants. There is undoubtedly some wastage, but since at any time about 300 separate investigations are being subsidised it is not surprising that all the geese chosen do not develop into swans. At the worst, however, no one suffers from the opportunity of trying his hand at research and often the results exceed expectation, both in the actual outcome of the investigation and in the training of scientific method gained by the grantee.

One point that ought to be realised is that the Council provide money not to institutions but to individuals because it is essential to control the choice of the worker and the type of investigation. Much trouble and criticism have arisen through lack of appreciation of this rule. A university or hospital planning a scheme of medical research which they cannot completely finance should consult the Council if they wish for financial support before the personnel are appointed.

After a personal or expenses grant is once made, the rein is held very slack, and the worker is given full freedom to develop his problem. He is encouraged to keep in touch with other investigators studying allied subjects and it is the duty of the Secretary to help him in every way. Apart from submitting a short statement each year to be grafted into the annual report of the Council and the return of vouchers for expenses, the grantee has absolute liberty and his work is generally allowed to continue for three years. By this time the worker, if at all successful, qualifies either for a further grant or for one of the many fellowships now established or is placed in a post allowing research facilities. By this means also many young clinicians are given an opportunity both to research and to establish themselves.

This interest of the Council in providing personal and expenses grants must not be viewed too narrowly in terms of discovery ; its influence in recruitment and education must also be taken into account.

RESEARCH FELLOWSHIPS

One other activity of the Medical Research Council touches this College closely—the policy of awarding travelling fellowships in research. The major part of these is generously financed by the Rockefeller Foundation of New York and another part is paid out of the Council's private endowments, all awards being at the discretion of the Council.

Each year a large number of applications for these fellowships is received from young medical men with excellent medical and scientific records. Last year 19 went abroad for a year's study, mostly to America, under these schemes, and in the course of 15 years 131 men and women have had this opportunity, of whom 33 were appointed to study tuberculosis. Of the first 79 Rockefeller fellows, 19 have been elected to professorships and many others hold important academic posts. A large number of the prominent young medical men in this country—both in clinical and laboratory work—will be found among the past holders of travelling research fellowships.

There can be little doubt that this enterprise is one of very great benefit to medical science.

RESEARCH FOR GOVERNMENT DEPARTMENTS

Questions of health and disease in all their aspects are assuming greater prominence in the view of Government departments and the assistance of the Medical Research Council is more and more in request. Mostly the demand is for investigation which will lead to a practical solution of difficulties. Such inquiries may be unattractive to workers either because an effective answer to the problem can be foreseen and only routine work is needed to produce it, or because the problem is so difficult that it seems doubtful whether a categorical answer expected will emerge.

A sample of the first sort of problem is the need to investigate systematically the toxicity of solvents, especially volatile ones, used in industry. A sample of the second type is the high incidence of chronic pulmonary disease which simulates and may be closely related to silicosis, a condition common among certain groups of miners in South Wales. The ætiology of silicosis is itself obscure and the subject of chronic pulmonary disease simulating silicosis bristles with difficulties. The questions constantly asked in Parliament about the progress of the work, although inevitable under the circumstances, do not ease the task of those responsible for the large investigation now being made.

On the other hand some of the problems raised by Government departments are welcomed because they are likely to yield a rich harvest—e.g., in tropical medical research.

The Council have sent a number of trained workers to different parts of the tropical Empire and have also embarked on a scheme for training young men in research in tropical diseases. Quite recently they have also appointed a small number of experts to direct and coördinate a large nutritional survey in many colonial territories. This important survey, which will include agricultural, economic, social, and anthropological inquiries, as well as dietetic and nutritional, has been undertaken with the object of finding the most natural and economic means for raising the standard of health and efficiency of all living in these territories.

Everybody will approve the growing habit of calling in the aid of the three departments of applied science—the Department of Scientific and Industrial Research, the Agricultural Research Council, and the Medical Research Council—as a great advance in government, and this part of the activity of the Medical Research Council is of the utmost importance.

Initiative in Research

As to the actual research supported by the Council, the initiative rests with the Council in so far as the choice of permanent staff is concerned. This choice depends on the merits of each member and on the subject he represents, though once appointed the staff have wide liberty of action in planning investigation. In the work subsidised by personal or expense grants the initiative lies solely with the investigator.

The Council seldom choose particular diseases for investigation ; generally the choice is of a broader nature, so as to include a group of diseases or a type of treatment of wide application or a system of physiological control.

For instance, the decision to encourage the study of *virus diseases* in the early days of the National Institute for Medical Research led to the appointment of a staff of workers under Sir Patrick Laidlaw, F.R.S. The initial choice of distemper in dogs for investigation allowed direct animal study and a freedom for experiment that could not easily be got by the study of a human virus disease. Everybody knows the fine results obtained which not only provided a method of preventing distemper but allowed the extension of the research to other virus diseases and in particular to epidemic influenza, when the ferret method of study was discovered.

More recently the Council decided to extend their interests in *endocrinology* and appointed Mr. A. S. Parkes, D.Sc., to lead this work. An energetic team is investigating endocrinological problems from all angles and also working in close harmony with other workers on the laboratory and clinical aspect of the subject throughout the country.

The decision of the Council to implement their wish to develop investigation of *chemotherapy* on a large scale was made possible by substantial financial aid for this purpose from the Treasury. The expansion of this new work had to be delayed because it necessitates the rebuilding of the National Institute on another site.

These are some examples of the kind of initiative in specific research shown by the Medical Research Council. In a sense, all their appointments to the permanent staff are made with this object, since the policy is to create posts for suitable men in the subject to be stimulated and not to appoint men to established posts.

Clinical research.—The desire of the Council to encourage clinical research by the setting up of clinical units is now well known. This programme is being slowly but steadily developed, and as men suitable for appointment to posts of this nature appear, more units will be set up. If clinical research is to enter into its kingdom, success in its early enterprises must be obtained and this can only happen if first-class investigators are appointed to these posts.

It will be clear why the Medical Research Council have not usually adopted the practice of making an organised attack on special diseases such as rheumatism and cancer, although of course they support much individual research in these subjects. Extensive ad-hoc research on a disease like rheumatism, however important as a practical problem, is liable to be unprofitable until the master key of its ætiology or some other essential fact has been disclosed. This master key is just as likely to be discovered by the use of the experimental method over a wide field as by directly studying a particular disease in which the experimental method is hardly available. The success of team-work depends either on brilliant leadership or on the working out of a special line of inquiry, usually supplied by the observation of one individual. The difficulty is not to arrange team-work but to find the outstanding individual discoverer, the Harvey, to blaze the trail.

Some Criticisms Answered

Criticism is often made of the type of medical research supported by the Council. Some say that this work is generally too academic and includes too many problems of biochemistry, biophysics, and physiology at the expense of clinical research and direct attack on disease. The opposing school say that more money ought to be used for the support of fundamental research in medical science from which all major discoveries have come. The fact is that there is no royal road to discovery in medicine and all we know is that the experimental method used by Harvey with such brilliant results is still the sure method for acquiring knowledge and "searching out nature."

Claude Bernard took the view that all experimental medicine was applied physiology, a view successfully challenged by the results of the investigations of Pasteur, Koch, and of the army of bacteriologists who followed them. When all disease came to be regarded as due to the invasion of the body by some form of materies morbi, the body itself was either forgotten completely or attention was mainly confined to the blood and its immunological powers. In more recent times, the Claude Bernard philosophy has received wider acceptance. The sooner the investigator recognises the truth of both the physiological and the invasive bases of disease and the close interaction of these factors, the quicker will be the advance of medicine. Defence of the body against invasion by pathogenic micro-organisms represents a physiological process and there ought to be no dividing line between the two aspects of the subject for the wise investigator.

My predecessor, Sir Walter Fletcher, whose wisdom in guiding the policy and action of the Medical Research Council for the first 19 years was exceptional, was strongly imbued with the Claude Bernard point of view and played no small part in encouraging the revival of this philosophic outlook on medical research. It is a point of view requiring wise interpretation and tends to mislead those of narrow orthodox outlook who think of physiology in terms of the text-book. To take an instance of this :—

Defects of vision and hearing being the two commonest and most widespread calamities of modern life the Medical Research Council set up two committees in 1925 and 1928 to help in the attack by research on these diseases. The names "physiology of vision" committee and "physiology of hearing" committee suggest that defective vision and hearing will be controllable when the physiological mechanisms of the eye and ear are understood, and were not intended to disorientate research and restrict the investigations to purely fundamental and academic problems. But I remember, soon after I became secretary of the Council, asking a prominent member of one committee why no research was directed to such common defects as middle-ear disease and otosclerosis, reminding him that about 2,500,000 people in this country were reputed to suffer from a disabling degree of deafness. He answered that he had not realised that such work came within the terms of reference of the committee.

This represents a common attitude of mind of physiologists towards medical research and yet outstanding success in discovery has followed the extension of interest by the physiologist into a function going wrong. Again and again we have seen points of major physiological interest established by work on the pathological side.

What would we know at present about such things as vitamins B_1, C, and D, insulin, thyroxine, cortin, liver and stomach active principles of pernicious anæmia, if experimental research had not been directed to the abnormal? Yet all these are physiological substances of the first order. Who can doubt that the physiology of the eye would be greatly extended by a knowledge of glaucoma, of the blood-vessels by a knowledge of the cause or causes of hyperpiesis, of the heart by a knowledge of the causes of auricular fibrillation, of the kidneys by a knowledge of albuminuria, and of the alimentary tract by a knowledge of gastric and duodenal ulcer, appendicitis, and colitis. It is hardly more unlikely that a physiological truth will come out of an experimental study of a pathological condition than that a fact of pathological significance will result from a purely physiological study. Every man working on a problem from either angle ought to be familiar with the other aspect. In recent years the Medical Research Council have endeavoured to diminish the gap between them by offering studentships to highly qualified young men for experimental pathology as well as for clinical investigation. The best qualification for such men is undoubtedly a good training in physiology, and physiologists in general would find a greater opportunity for essential discovery if they realised that a study of abnormality of function often offers the key to the elucidation of the normal process. Harvey himself did not confine his observations to one aspect of his problem. When necessary he called up evidence from every branch then known of physiology, pathology, and clinical medicine to support his argument.

We must continue to break down these artificial barriers between the medical sciences. It is true that each subject is now so big that any one man can only be a master of a small part of it; but expert assistance is so easily available that the investigator need only know sufficient about related problems to realise when to call for such assistance. Even the pure chemist and physicist now show great readiness to join in solving biological problems and workers in medical science can generally count on their help.

The Future

And now, what can be said of the future ? Short of a catastrophic change which may upset or even destroy national life, the future of medical discovery is bright. Past experience shows that whatever problem concerning the body can be formulated by the human mind, a solution or partial solution of it is possible. There is no doubt that more and more knowledge giving control, both preventive and curative, of disease will be obtained. The limiting factor in this progress will always be the men of genius to make the first-class discoveries, but with the spread of educational opportunities to poorer people, more of these men may present themselves. Now that the State have put their hands to the plough, no unsurmountable difficulty may be expected in the direction of finance, if the situation is handled wisely.

The difficulty I foresee is not that of obtaining knowledge but of its application to human needs. Undoubtedly, as in the past, curative remedies as they appear will be generally taken up by the medical profession. Much of the new knowledge to be gained, however, may concern the prevention of disease and especially of chronic and degenerative diseases, including cardiovascular disorders, rheumatism, and pulmonary disease. The adoption and application of this knowledge will generally depend on the degree of education and wisdom of individuals. In some cases it will involve Government action. Without an enlightened public opinion the average person will do nothing to save himself and the State even less. If we are to continue as a successful democracy, dependent on public opinion for action, this must be guided suitably and quickly in problems of health as in other matters.

It seems to me that one of the most important functions of this Royal College in the future will be to lead public opinion and to guide State departments, especially in matters of preventive medicine. I have already explained why the Medical Research Council cannot advertise the value of the discoveries of its investigators, or continually interpret these discoveries to the public. Their job is solely to promote discovery, not to educate either the profession or the public. The Royal College of Physicans, on the other hand, is an ideal body for giving guidance and pressing for action, if such be needed, when scientific discovery has supplied new knowledge of importance to public health. Its independence and freedom from political relations and the high and honourable standing of its fellows would give its edicts an unassailable power. Consider one instance where the College could have played a decisive part. We are all familiar with the shocking neglect in this country to make use of available knowledge to prevent diphtheria by preventive inoculation. Whereas in some places, for instance in the province of Ontario, diphtheria has been practically eliminated, in this country there are more than 50,000 cases of the disease annually and 3000–4000 deaths. Surely this situation would not have arisen if there had been an organisation in the authoritative position of the College to give the lead and to indicate at an early stage the right action to be taken.

Other instances could be given and many others will arise in the future. It cannot be doubted that this great gap between medical discovery and the public requires serious attention.

I have now completed my task of giving a bird's-eye view of the modern movement of State support for medical research. It would be idle to pretend that the State or any other body could do much more in this matter than supply facilities to assist and guide the natural genius of the country in studying problems related to health and disease. Much remains to be done but, bearing in mind the limitations of any such enterprise, it will probably be agreed that the entry of the State into this field of discovery has been both stimulating and fruitful.

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